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UNITED STATES DEPARTMENT OF AGRICULTURE
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July 23, 1931.

Director,
Great Basin Experiment Sta.,
Ogden, Utah.

Dear Sir:

We are sending you herewith a copy of the tenth annual report and program of the Appalachian Forest Experiment Station. This outlines in brief the past work of the Station and its plans for the immediate future.

Up to the present year the Station's investigations have dealt almost entirely with the growth and protection of timber as a commercial crop, as outlined in the report. This year a new field is being entered - that of the relation of forest and other vegetative cover to the regularity of streamflow and to erosion. This subject is of special importance in the Southern Appalachian region because of the large number of rivers which have their sources in the mountains. Conditions at their headwaters undoubtedly have a definite relation to the height and persistence of flood stages, the sedimentation of stream channels and storage reservoirs, and the general behavior of the rivers. You will find this project very briefly outlined on pages 32-33 of the report.

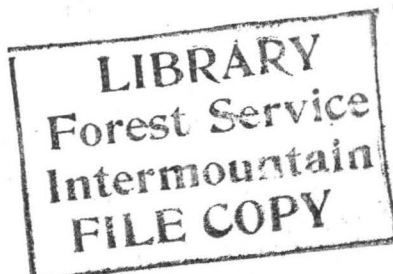
The Station is anxious to receive comments and suggestions as to its work and will appreciate any you may care to make.

Very truly yours,

E.H. Brothman

Director.

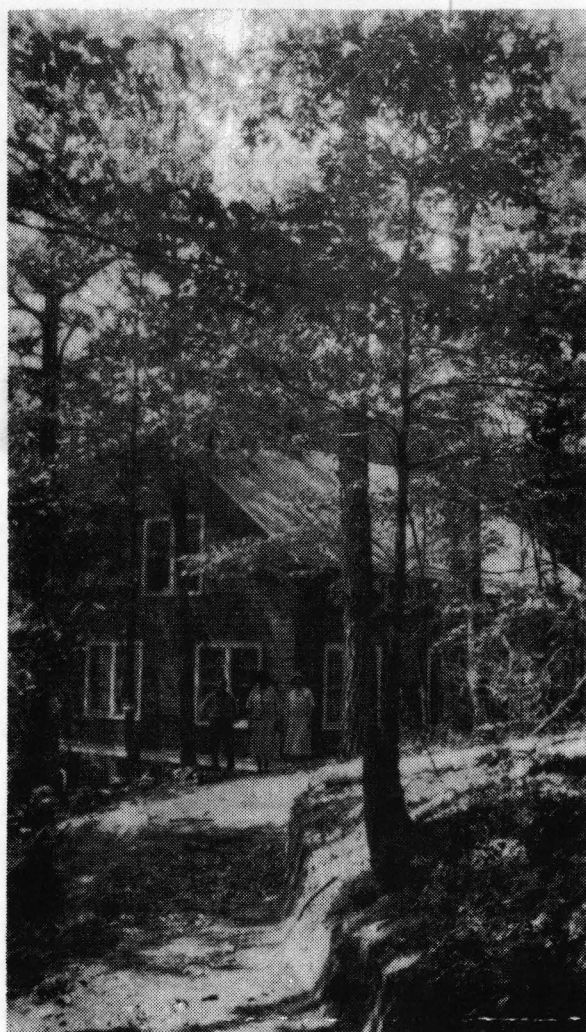
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TENTH ANNUAL

REPORT AND PROGRAM

APPALACHIAN

FOREST

EXPERIMENT

STATION

1930-1931

Bent Creek Field Laboratory

C O N T E N T S

	<u>Page</u>
Personnel of the Station.....	a
Appalachian Forest Research Council: 1930.....	b
Territory of the Station.....	2
Finances.....	2
Estimated expenditures, Fiscal Year 1932.....	3
General Station activities in 1930.....	5
Cooperation.....	5
Branch stations, experimental forests and natural areas.....	5
Administrative changes in 1930.....	6
Appalachian Forest Research Council.....	6
Miscellaneous events of interest.....	9
Current investigative projects.....	13
Management.....	13
Protection.....	25
Fire studies.....	25
Forest pathological investigations.....	30
Forest insect investigations.....	31
Forest influences.....	32
Forest measurements.....	33
Planting.....	34
Botanical studies.....	35
Biological investigations.....	35
Special investigative needs.....	37
Forest survey.....	37

APPALACHIAN FOREST EXPERIMENT STATION

PERSONNEL, 1930

E. H. Frothingham	Director
C. F. Korstian (Resigned Nov. 5, 1930)	Senior Silviculturist
C. R. Hursh	Forest Ecologist
L. I. Barrett	Associate Silviculturist
J. H. Buell	Assistant Silviculturist
I. H. Sims	Assistant Silviculturist
A. L. MacKinney	Assistant Silviculturist
C. A. Abell	Junior Forester
Margaret C. Stoughton	Junior Forester
Josephine Laxton	Senior Clerk
Elisa M. Pearson	Clerk
Lillian B. King	Stenographer

BUREAU OF ENTOMOLOGY

R. A. St. George	Associate Entomologist
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BUREAU OF PLANT INDUSTRY

R. M. Nelson	Assistant Pathologist
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BIOLOGICAL SURVEY

T. D. Burleigh	Associate Biologist
----------------	---------------------

TEMPORARY ASSISTANTS, 1930

Forestry

Willard Bromley	Pa.	Ben Lucas	Ohio
C. R. Cochran	Ohio	Charles Nuite	S.C.
J. C. Craig	Mich.	Hugo Pawek	Minn.
R. K. Daley	Conn.	C. F. Phelps	Pa.
Vernon Hicks	Ill.	Laurence Sluzalis	Pa.
N. J. Larsen	Denmark	Bonnell Stone	Ga.
H. J. Loughhead	Pa.	R. B. Wooten	S.C.

Biology

Winston Jackson	N.C.
-----------------	------

Entomology

Ralph Caird	Ill.	Hugo Pawek	Minn.
Bernard Huckenpahler	Minn.		

Pathology

R. L. Randolph, Jr.	N.Y.
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APPALACHIAN FOREST RESEARCH COUNCIL

MEMBERSHIP IN 1930

W. D. Tyler

President

J. H. Pratt, Chairman of Executive Committee

Kentucky

T. P. Cooper, Director, Kentucky Agr. Experiment Station,
Lexington.

W. J. Hutchins, President, Berea College, Berea.

North Carolina

G. A. Cardwell, Atlantic Coast Line Railway, Wilmington.

Andrew Gennett, President, Gennett Lumber Co., Asheville.

J. S. Holmes, State Forester, Raleigh

J. H. Pratt, Consulting Engineer, Chapel Hill.

Verne Rhoades, Consulting Forester, Asheville.

R. B. Robertson, President, Champion Fibre Company, Canton.

South Carolina

H. L. Tilghman, Tilghman Lumber Company, Marion.

Tennessee

S. F. Horn, Editor, Southern Lumberman, Nashville.

R. S. Maddox, State Forester, Nashville.

Virginia

P. R. Camp, Camp Manufacturing Co., Franklin.

J. P. Hummel, Hummel-Ross Fibre Corporation, Hopewell.

Chapin Jones, State Forester, Charlottesville.

W. D. Tyler, Clinchfield Coal Company, Dante.

George L. Wood, R. E. Wood Lumber Company, Hotchkiss.

West Virginia

T. H. Clagett, Chief Engineer, Pocahontas Coal & Coke Co.,
Bluefield.

George D. Curtin, Pardee & Curtin Lumber Company, Clarksburg.

John Raine, Meadow River Lumber Co., Rainelle.

TENTH ANNUAL REPORT AND PROGRAM
APPALACHIAN FOREST EXPERIMENT STATION

1930-1931

The Appalachian Forest Experiment Station is one of eleven stations maintained by the United States Forest Service to study forest conditions and problems in the different forest regions of the United States. The Appalachian Station was established July 1, 1921, with headquarters at Asheville, N. C. Its territory comprises three distinct regions: the Appalachian and Cumberland Mountains from West Virginia to Georgia; the plateau regions on both sides of the mountains; and the Atlantic Coastal Plain of North and South Carolina and Virginia. This large territory contains many different types of forest that constitute the subject matter for the investigations outlined in the following pages. This report briefly summarizes the previous work -- particularly in 1930 and the first quarter of 1931 -- and outlines the activities proposed for the remainder of 1931 and later.

Territory of the Station

Up to the present the Station has worked chiefly in the mountain forests. The mountains are a typically forest region, rugged and with little agricultural land. The forest is mainly of hardwoods. Most of it has been heavily culled or cut over and damaged by fire. Most of the problems encountered have to do with restoring good growing conditions, increasing the proportion of desirable tree species, determining the kind and amount of damage done by fire, testing different tree species for planting, protecting and maintaining game, combatting forest insects and diseases, and studying the protective value of forest cover on watersheds to reduce erosion and improve streamflow conditions.

The Piedmont and other rolling plateaus that surround the mountains, and the great Appalachian Valley that separates the two principal mountain systems, are well populated farming and industrial regions in which the timbered area, which is very large in the aggregate, is made up mostly of farm woods. The aggregate size of these wooded tracts and their nearness to markets make them important sources of forest products. The character and distribution of ownership introduce special problems of management. As yet, however, the Appalachian Station has not had sufficient funds and personnel to warrant investigation of the forest problems on the plateaus.

On the Coastal Plain the two predominating types of forest are the pine forest - chiefly of loblolly, or North Carolina pine - that covers extensive plains, and the swamp hardwoods and cypress of the broad stream bottomlands. Practically all the pine is of second-growth. It offers great commercial possibilities because of its rapid growth and its value both for lumber and for paper pulp. The swamp hardwoods forests also are of promise for both lumber and pulp. The Station's work in this region has been limited to a study of southern white cedar and a small beginning in the investigation of growth and management of loblolly pine. Studies commensurate with the value and extent of these forests will require a considerably larger financial authorization than the Station has yet been able to obtain.

Finances

July 1, 1931, will be the Station's tenth anniversary. Within its relatively brief existence there have been material changes in the personnel, resources, activities, and even the territory of the Station. These changes have come about mostly in the last four years. Until the fiscal year 1926 (beginning June 30) the annual allotments were between \$17,000 and \$21,000, which provided a permanent staff of four technical men and a clerk. Chiefly through increases of \$18,000 in Fiscal Year 1927, and of \$5,000 in Fiscal Year 1931 (for work in Georgia) the Station's annual appropriation has been raised to approximately \$45,000. The permanent staff now numbers eleven; of the original staff only two remain.

The major investigations now in progress fall under the heads of forest management and protection. In addition a small amount of work is done each year in studies of forestation (relating to the raising of timber crops from seed) and in other minor investigations. The distribution of expenditures on these subjects during the Fiscal Year 1930 (ending last June) is shown in the following table:

Expenditures for Investigations

Fiscal Year 1930

		<u>Per cent</u>
Management	\$26,109	65
Protection	8,588	21
Forestation	1,345	3
Tree studies	1,018	3
Miscellaneous	<u>3,313</u>	<u>8</u>
Total -	\$40,373	100

The work on tree studies consisted in the preparation of manuscripts for publication, covering the results of past field work by the Station. In the above table the cost of administration and improvements, amounting to \$13,450, has been prorated.

In 1930 increased attention was given to the studies under the head of "protection" (influence of fire upon trees and soil), and during the fiscal year to begin July 1, 1931, it is probable that 29 per cent of the Station's allotment will be spent on these investigations. Next summer, also, a new subject, relation of forest cover to streamflow and erosion, will be given 13 per cent of the allotment, which will be increased to about \$51,120 for the purpose. As nearly as can be anticipated the expenditures for the next fiscal year will be as follows:

Estimated Expenditures by Projects and Lines of Work.

Fiscal Year 1932

<u>Projects</u>	<u>Estimated expenses</u>
<u>Mountain forests</u>	\$
<u>Management</u>	
Methods of cutting and natural reproduction (Mc-2)	4,900
Thinnings in mountain hardwoods (Mt-2)	
Thinnings in Biltmore Estate plantations (Mt-1)	
Management studies in north Georgia (M-2)	4,700
Bent Creek experimental forest (M-1)	3,400
Natural replacement of chestnut (M-3)	450
	13,450
<u>Protection</u>	
Effects of fire on forest soils (Pf,A--1)	6,200
" " " " trees " "	4,600
	10,800
<u>Mensuration</u>	
Rate of growth in irregular stands (ME - 2)	2,950
Growth sample plots (ME - 1)	2,950

Influences

Effect of cover conditions on streamflow
and erosion.

(I - 1) 5,100 5,100

Planting

Test of species: spruce type (Fp-3), hardwood
types (Fp-4)

400

General study of plantations (Fp-2)

- 400

Botanical studies

Periodicity of vegetative activity in trees (BS-1)

350 350

Coastal forests

Management

Reproduction, growth, and management of loblolly
pine - -

(M-111) 2,000

Thinnings in southern pines -

(Mt-3) ---- 2,000

Protection

Effects of controlled burning - (Pf, C-3)

450 450

Undistributed - 3,500

Total allotted to investigations - 39,000

Administrative salaries and expenses - 12,120

Station allotment (approximate) \$51,120

In addition to its allotment of \$45,120 for the present fiscal year, the Station has received \$31,000 from the appropriation for unemployment relief. Of this, \$11,000 is being spent on road and bridge construction on the Bent Creek experimental forest. The remainder will provide five small buildings and a greenhouse at Bent Creek, together with telephone, electricity, water, and incidental improvements. The buildings will comprise three laboratories, a mess hall, and quarters for a resident ranger.

General Station Activities in 1930

Cooperation

The increase of \$5,000 that became available July 1, 1930, was for forest investigations in northern Georgia. This work is reported on another page. It is expected that the results of the first season's work, done in cooperation with the Georgia State Forest Service and the Georgia Agricultural Experiment Station, will be in shape for publication this year as a Georgia State forestry bulletin.

Cooperation has continued with the Bureaus of Entomology and Plant Industry through their local representatives, R. A. St. George and R. M. Nelson. In January, 1930, the Biological Survey began similar cooperation and assigned T. W. Burleigh to the Station to conduct studies of game and other wild life in its relation to forest management

Branch Stations, Experimental Forests, and Natural Areas.

Shortly after the Station was established three branch stations were organized and work was started at them. These branch stations are located on the Shenandoah National Forest in Virginia and West Virginia; at Berea, Ky., where sample plot studies in cooperation with Berea College are under way in the forest tract belonging to the College; and in the Bent Creek ranger district of Pisgah National Forest, near Asheville, N. C. At the latter point an experimental forest of about 1,100 acres has been established. This has been cruised, mapped, and subdivided into 21 working units. One of the major activities of the methods of cutting study this year has been the establishment on the experimental forest of five sample areas which have been cut over in different ways as a test of methods. These cuttings, covering an area of about 40 acres, are described elsewhere in this report.

Associated with the organization of branch stations and experimental forests is the selection of natural areas, consisting of representative timber tracts to be reserved as samples of the natural forest. In cooperation with the Pisgah National Forest, one such area on the east slope of the Black Mountains, near Mount Mitchell, was visited. Pending further examination no report was made on this tract. Its location, and the character and beauty of the spruce and balsam timber that covers most of it, strongly suggest that it should be reserved and developed to the extent desirable for a natural area.

A smaller tract on the Pisgah National Forest was inspected by members of the staff in company with Supervisor Mattoon, to determine its suitability for reservation as natural areas. This is a virgin stand of hemlock and hardwoods on Neals Creek, South Toe River drainage. It covers only about 300 acres, but is representative, and its location near the head of the creek valley between slopes that will protect it argues in favor of its reservation. Three other areas on the Pisgah are also under consideration. These are (1) a tract of 300 to 400 acres at Big Ivy, largely old-growth hardwood timber extending some distance up Corner Rock Creek; (2) a stand along the Pisgah Motor Road, on McKinney Creek; and (3) 400 acres of spruce at the head of Davidson River. On other national forests areas which have been mentioned as suitable are Ramseys Draft, Shenandoah National Forest (old-growth running heavily

to hemlock); virgin timber at the headwaters of the Nantahala and perhaps also the Cullasaja, Nantahala National Forest; and virgin hardwoods and white pine in the Toccoa Basin, Cherokee National Forest.

Administrative Changes in 1930.

Dr. C. F. Korstian, one of the five members of the Station's original staff, resigned in November to accept appointment as professor of forestry at Duke University and director of the Duke Forest. Miss Margaret Stoughton joined the staff in July as Junior Forester, and L. I. Barrett, formerly of the Central States Forest Experiment Station, was transferred to the Appalachian Station January 1, 1931, as Associate Silviculturist.

In December, 1930, the Station moved from the Asheville City Hall to the new Federal Building. This change gives the Station and its cooperators a much needed increase of space - from seven rooms in the City Hall to thirteen in the new quarters. Two of the rooms have been equipped as laboratories for soil and pathological investigations. One desirable feature of the new location is the presence in the same building of the Pisgah National Forest headquarters, the North Carolina District Forester, the Geological Survey, and the Weather Bureau.

Appalachian Forest Research Council.

The Council was organized in 1925 through the appointment by the Secretary of Agriculture of 24 men prominent in the lumber, pulp and paper, mining, railroad, and other industries, State foresters, State Agricultural Experiment Stations, and other State officers. Its purpose is to enlist interest and cooperation in the development of forest research and to serve as an advisory board for the Station.

The result has been extraordinarily good. The Council has shown an exceedingly helpful interest in the Station's work from the start. The individual members have contributed their time and the expense of travel to the meetings, and through resolutions and individual activity have been very largely responsible for the development of the Station along new and important lines.

The Council has held six meetings: at Asheville, N. C., February 1925; at Richmond, Va., January 1926; and at Asheville in August 1926, October 1927, May 1929, and May 1930. At each of the meetings reports on current research activities have been presented by the Experiment Station and its cooperators, including the State foresters of the region, and these have given rise to constructive discussion and suggestions. At the first meeting the Council passed a resolution urging the Department of Agriculture to assign a forest pathologist and a forest entomologist to conduct investigations in cooperation with the Appalachian Station. Each of these assignments was later made. Similarly, the Department was asked to place a biologist at the Station for studies of game management and of wild life, and this request was granted last year through the appointment of T. W. Burleigh, local representative of the Biological Survey. Resolutions by the Council have called the attention of the United States Weather Bureau to the desirability of investigations in the Appalachian region leading to the development of a fire weather prediction service, and funds for this purpose were appropriated at the last session of Congress.

At the May, 1930, meeting of the Council the following resolutions were passed:

I. Coastal Plain

The forests on the Atlantic Coastal Plain are of outstanding importance because of the rapid growth and varied commercial value of the coastal pine and hardwood species, and the development of industrial plants dependent upon continued forest production. The Council therefore feels very strongly that forest investigations should be started in the Atlantic Coastal region at the earliest possible date on a scale commensurate with the industrial value of these forests. It believes that the sum of \$50,000 should be devoted to this purpose.

II. Forest fire

The forest fire weather warning service now in effect in several forest regions of the United States is reported as very satisfactory. An extension of such service to the Southern Appalachian region is regarded as of the greatest desirability, and the Council therefore respectfully suggests to the Secretary of Agriculture that funds authorized by the McSweeney-McNary Bill, Section 6, for the purpose of investigations preliminary to such service be made available for studies of inflammability of forest fuels and for such other studies as may be necessary. It is believed that the amount of \$15,000 should be provided for this purpose.

III. The Council is much concerned over the danger of destruction by fire of the work on the Appalachian Forest Experiment Station at Bent Creek and other places on the national forests, and respectfully suggests to the Secretary of Agriculture that immediate steps be taken to ensure the protection of these areas. The Council further recommends the prompt passage of the Englebright Bill (H. R. 3245) which should ensure sufficient funds to enable the United States Forest Service to give adequate protection to all such experimental areas on the national forests.

IV. Influence of forests on streamflow and erosion

Believing that forest conditions at stream heads have a very important relation to the length of life of power reservoirs and to the security of property from floods and deposition in the lower river valleys, the Council earnestly recommends to the Secretary of Agriculture that a comprehensive study of the relations of forests and other cover to streamflow be undertaken at an early date in the Southern Appalachian mountain region, with the combined efforts of the Forest Service, the Weather Bureau, and other appropriate bureaus of the Department of Agriculture, and of the Geological Survey and State agencies, and that an annual appropriation of \$30,000 be provided for this purpose.

V. Continued soil erosion throughout the Southern Appalachian region which has largely resulted from the denuding of cut-over forest land and the abandonment of farm land, has caused great economic losses to agriculture, commerce, industry, and community life. The Council believes that there is need for a

study of measures which will prevent further erosion from such lands, and therefore recommends to the Secretary of Agriculture that he include in his 1932 budget an item of at least \$10,000 for such a study.

VI. Timber survey

The Council calls attention to the proposed cooperative study of social and economic conditions in the Southern Appalachian Mountains, and suggests that the United States Department of Agriculture take advantage of the opportunity afforded to extend the national survey of forest resources, now being carried on in the Pacific Northwest, into the Appalachian region contemporaneously with the social and economic study.

VII. Forest entomology and pathology

The Council commends the Bureaus of Entomology and Plant Industry on the high technical quality of the work done at the Appalachian Forest Experiment Station in the past by representatives of these Bureaus, and suggests that the personnel and scope of the investigations be materially strengthened as soon as possible.

VIII. Forest biology

The Council highly approves the assignment of a biologist, representing the United States Biological Survey, to the Appalachian region to cooperate with the Appalachian Forest Experiment Station. Because of the growing value of game as a forest resource and the significance of animal life in timber production, the Council believes that the services of more than one man are needed in this work, and that early provision for a reasonable increase in this personnel be made by the Department of Agriculture.

Addressed to the Governors of States in the Southern Appalachian Region:

IX. Forest fire

The unusual losses which occurred during the spring fire season of 1930 has prompted the Council to bring to the attention of the governors of the States served by the Appalachian Forest Experiment Station the prime importance of providing sufficient funds for adequate fire control. We urge them to bring strongly to the attention of their respective general assemblies the necessity for providing such funds.

- X. Hunters and fishermen are responsible for a large number of forest fires occurring throughout the Southern Appalachian region, which are a serious detriment to their own interests; and while a number of States have already adopted measures to prevent hunting and fishing during periods of high fire hazard, several of the States have no such regulation. The Appalachian Forest Research Council therefore suggests to the States covered by the Council that they adopt such necessary legislation or regulations as will empower the governor or other designated officer to close all hunting and fishing at any time during the open seasons when high fire hazard exists.

Addressed to the Appalachian Forest Experiment Station:

XI. Publication of investigative results.

The Council again calls the attention of the Station and the Secretary of Agriculture to delays in the publication of investigative results, and urges the importance of making such information available to the public without undue delay. The Council offers its advice and assistance towards this end, and as a means of keeping informed as to the progress of research results, completed or in preparation, it requests the Station to report the status of such work semi-annually, to a committee of two Council members to be appointed by the by the President of the Council.

In the death of Major George L. Wood the Council lost an esteemed and valuable member. Added to Major Wood's experience as a lumberman was a keen appreciation of the need of research and an understanding of its objects and methods. He took a lively interest in the affairs of the Council and his loss will be deeply felt.

Miscellaneous Events of Interest in 1930 and the First Quarter of 1931.

New State foresters and forest supervisors. Because of the cooperative relations between the Station, the State foresters, and the national forest supervisors in the region, changes made in these offices are of interest. During 1930, J. O. Hazard, formerly Assistant State Forester of Virginia, succeeded R. F. Maddox as State Forester of Tennessee, and early in 1931 H. A. Smith, who had been Assistant State Forester of Florida, was appointed State Forester of South Carolina, to succeed L. E. Staley. C. L. Graham and J. W. McNair, formerly assistant supervisors on the Pisgah National Forest, were made supervisors of the Unaka and Shenandoah National Forests, respectively, taking the places left vacant by the transfer of Supervisors Broadbent and Shields.

Study of forest taxation in North Carolina. As a part of the Tax Inquiry now being conducted by the Forest Service, a special study of forest taxation was made in three counties of North Carolina by Paul Wager and R. B. Thomson, under the direction of R. C. Hall. The counties of Beaufort (coastal plain), Chatham (Piedmont plateau), and Macon (mountain region) were selected for this work. A basic part of the study was to determine the area, stand, and growth rate of the forest in these counties, and the information obtained has already been of considerable use to the Station. In Beaufort County, also, the Southern Forest Experiment Station conducted a part of its study of financial aspects of forestry.

Developments in the fire damage study. In April, 1930, a forest fire on the Arcadia district of the Natural Bridge National Forest burned over three series of permanent sample plots on McFalls Creek, established by the Station in 1929. The usefulness of the plots as tests of different methods of cutting was of course destroyed; but the counts and measurements of the tree reproduction that had been made on the plots were utilized for the study of fire damage. The plots have been continued under the latter project.

The increased emphasis given the fire damage studies in 1930 is worthy of note. New methods were put into use leading to interesting findings as to the relative resistance of different hardwood species to fire. A series of controlled burning plots was established on the Bent Creek experimental forest. These items will be taken up later in this report, in the discussion of the fire damage project.

Preliminary survey of slash decay. The debris of tree tops, limbs, and cull logs left in the woods after logging usually constitutes a more or less severe fire danger and may affect tree reproduction. Whether it should be burned, piled and left to decay, or lopped and scattered is a problem affecting both the financial and the technical sides of forest management. Much depends upon the rate at which it decays. A brief survey to gather general information on the rate of slash decay was made in the coastal pine and mountain hardwood regions by Drs. Carl Hartley and Perley Spaulding, forest pathologists of the Bureau of Plant Industry, accompanied by Dr. Nelson and others of the Appalachian Station. In a memorandum discussing the trip on the Coastal Plain Dr. Spaulding says:

"The rate of decay here is evidently so rapid, and the evidence is all so strong that water logging probably prevails that it does not seem that lopping would be an efficient measure. Because of the rapid decay, lopping could not very materially hasten the passing of the extreme danger point. On the other hand, the probable prevalence of water logging might be a feature that would be worth considering in connection with its influence on reducing the fire danger, since it favors the formation of a wet, compact layer of slash which normally would dry out very slowly."

Of the mountain hardwood slash he says:

"All dead twigs, leaves, and branches below one inch in diameter constitute a real fire danger. These rot and disappear in three years in all of these timber species which are most numerous in the stand. It can, therefore, be said that in most places the extreme fire danger is over in three years. Slash is not usually dense. In most cuttings some shade is left. The best timber and the densest slash are on the cooler and moister slopes. It does not seem that lopping can decidedly shorten the already short rotting period, and in this situation it may lead to water logging.

"On warmer and dryer slopes lopping may hasten decay without water logging but at rather high cost. There is also danger of intensifying fire damage from more compact slash. On these slopes the fire danger continues longer in the number of years and in the length of season during the year".

Forest type classification. A general forest type classification for the eastern United States was brought closer to realization during the year by action at all the eastern forest experiment stations in cooperation with local sections of the Society of American Foresters. The movement is in the hands of a committee of the Society of which Professor R. C. Hawley is chairman. Professor Hawley visited the Appalachian region during the summer and made field trips with members of the Station and others. As a result of this visit and a number of meetings of the local committee a tentative agreement was reached as to the forest types to be recognized in the Appalachian region. When these are finally decided upon it is planned to

group them in related local classes, so that the broader groups may be used for purposes that do not require a more refined classification. It is hoped that the work for the entire East will be completed within the next two years.

Cooperative logging and mill-scale studies. A report embodying the results of the study of small saw-mill utilization of Southern Appalachian hardwoods has been issued by the Forest Products Laboratory in two parts, the first covering the work done on the Pisgah National Forest and vicinity and the second that done on and near the Shenandoah National Forest in West Virginia and Virginia. A similar report, for the selective logging and mill-scale study of loblolly pine near Franklin, Va., is being revised, for publication by the Virginia State Forest Service. The Appalachian Station and its cooperators assisted the Laboratory in the field work on these projects and later in the preparation of the reports.

Cumulated index to periodical literature of forestry. The Station actively cooperated with the Appalachian Section of the Society of American Foresters in the preparation of the "Cumulated Index" to the Proceedings of the Society, the Forestry Quarterly, and the Journal of Forestry. This was completed and published by the Society in 1930. It affords a classified index to the principal periodical literature on technical forestry in America through 1929.

Unemployment relief on Bent Creek experimental forest. The critical situation resulting from unemployment in and near Asheville during the winter of 1930-31 brought about the organization of a Community Woodyard Committee. Men were employed by the Committee to cut cordwood, which was delivered in Asheville for \$5.00 a cord. About 800 cords of wood were obtained from the Bent Creek experimental forest, where this opportunity to effect the removal of trees marked for cutting on experimental areas was welcomed. The wood was cut in 8-foot lengths, trucked to Asheville, and sawed into lengths to order. Men were employed for three days each week, and were given a weeks rations in lieu of money.

The road building at Bent Creek, which has previously been mentioned, has kept about 40 men busy. A stretch of about four miles of road is now under construction, which will give access to most parts of the area not previously reached by road. A bridge across Bent Creek, at the end of the road nearest the laboratory, is to be built. Further unemployment relief will be afforded by the construction of the much needed laboratories, greenhouse, and quarters referred to on a preceding page.

Revision of statistics relating to timber production. Early in 1931 the Station was given the task of collecting statistics on forest area, stand, growth, and drain for the States of West Virginia, Virginia, North and South Carolina. This work is well under way and is expected to be completed by the end of April. Active cooperation has been obtained from the State foresters, national forest supervisors, and many others in these States, and special trips have been made by members of the Station staff in North and South Carolina.

Reports and articles of special interest received. Of the articles received that relate to subjects on the Station's program the following are of special interest:

A "Report on Survey of White Pine and Related Factors in the Southern Appalachians," by J. A. Cope, field agent of the Office of Blister Rust Control, describes the author's search for blister rust infection in this region during the summer of 1930, and the species of Ribes (gooseberries and currants) that were found. Only three species of Ribes were found, and these occur, generally speaking, in a higher altitudinal zone than white pine. No infection could be found and the author concludes that south of Virginia and West Virginia eradication of Ribes seems unnecessary. "Not only is protection of white pine from ribes feasible and relatively inexpensive in the Southern Appalachians, but also protection from white pine weevil presents little difficulty. In Virginia and West Virginia, evidences of white pine weevil work were noted in plantations and natural reproduction, but nowhere were more than 5 per cent of the young trees attacked. Probably the lack of large areas of open grown white pine****accounts at least in part for this condition. Another contributing factor **** is believed to be the activity of the downy woodpeckers. Nowhere in the North has the writer seen such thoroughgoing weevil control by means of birds."

A report entitled "The Effect of Thinning upon the Specific Gravity of the Wood of Northern White Pine", by Benson H. Paul of the Forest Products Laboratory, embodies the results of tests made on wood samples from thinned and unthinned portions of the Biltmore thinning plots carried under the Station's project Mt-1. The results so far as specific gravity is concerned are not conclusive, owing to the fact that samples were available from only three dominant trees - one on the thinned and two on the unthinned plot. This emphasizes the need for providing areas adjacent to such plots, from which sample trees of any description may be cut for tests. "Isolation strips" of this character are commonly made around plots, but they are ordinarily too narrow to permit removal of dominant trees, at least without interfering with the purposes of the experiment.

The following articles by Stanley A. Cain were received, constituting Volume 1, Papers 9 and 13 respectively, of Butler University Botanical Studies:

"Certain Floristic Affinities of the Trees and Shrubs of the Great Smoky Mountains and Vicinity".

"An Ecological Study of Heath Balds of the Great Smoky Mountains".

These papers are valuable contributions to the ecological literature of this region.

CURRENT INVESTIGATIVE PROJECTS

MANAGEMENT

The general purpose of the studies in forest management is to find practicable methods for increasing the productivity of existing forests. Because of the tremendous variety of forest conditions within even a single one of the three main divisions of the Station's territory, a large number of problems are presented. In the mountain region most of the timberland area has been cut over, some of it four or five times, and large parts of it have been severely burned. Logging generally removed only the merchantable timber and left many poor, defective trees standing to interfere with the on-coming second-growth. The latter has suffered a great deal from fire, which in many cases has increased the proportion of poor tree species and shrubs, or has changed a promising seedling reproduction into one of sprouts. Chestnut, formerly the most abundant of the mountain timber species, is rapidly being killed by the blight, and its loss will mean a profound change in the forest composition. In short, the mountain timberlands over hundreds of thousands of acres have reached a low ebb, and it is the purpose of the investigations to find the means for ensuring the best development of the succeeding stands.

On the Coastal Plain pine lands the situation is more promising. The problem of obtaining satisfactory stands after cutting is less complicated due to the strong reproductive capacity of the primary species, loblolly pine. The most important of the numerous problems requiring study are the determination of the most economical treatment suited to different stand conditions, that will perpetuate the stand through periodic cuttings, and a study of the most efficient methods of dealing with hardwood competition in cut-over stands.

Through the Station's territory there are scattered small stands of excellent second-growth that have come up on clear-cut areas or abandoned farms. These are of all ages and are frequently too thickly stocked for best growth. Some of the investigations in management are accordingly aimed to determine the kinds and degrees of thinning that will result in the most rapid growth of the best trees.

Separate projects are carried for the work in the mountain region on methods of cutting (Project Mc-2) thinning (Mt-1, Mt-2), natural replacement of chestnut (M-3), management studies in North Georgia (M-2), and the management of the Bent Creek experimental forest (M-1). During last summer's work in North Georgia permanent sample plots were established for growth study purposes which will serve also for both the methods of cutting and the thinning project.

The two projects under way on the Coastal Plain are studies of the growth, reproduction, and management of loblolly pine (M-111) and of thinnings in southern pines (Mt-3).

Improvement of Mountain Forests by Better Methods
Of Cutting (Project Mc-2) Conducted by E. H. Frothingham and J. H. Buell

Past work. The study began with experiments in different systems of cutting, carried out on measured sample plots of one half acre to three and one half acres. Up to last year 25 sets of plots had been established at seven different points in the mountain region, and on these the results of various systems of cutting are being periodically observed and measured. The experiments are adapted to the conditions found in representative stands. On some of the plots partial cuttings are being tried in which the stand has been opened up by the removal of defective or otherwise unpromising trees, admitting increased light and enlarging the growing space. The possible effect of this upon the establishment and character of reproduction and the increased growth of the promising larger trees that were left standing is being recorded in periodic measurements. On other plots experiments are under way to determine the cost and effectiveness of weeding out saplings of poor species that were outgrowing a desirable reproduction of better species.

Seven plots comprising four experiments in cutting, that were established last year on McFalls Creek, on the Natural Bridge National Forest in Virginia, were burned over in April 1930. The fire destroyed the effectiveness of the plots for the purposes for which they were originally intended, but the maps and records that had been prepared made these plots serviceable for the study of fire damage, to which they have been converted.

During 1930 and the first quarter of 1931, five areas in the Bent Creek experimental forest, near Asheville, were cut over in different ways. An area of six acres was clear cut, all brush and tree reproduction first being removed. The purpose of this is to learn what sort of reproduction will develop after an entirely clear cutting, as contrasted with the partial cuttings that were carried out on the other areas. One of the latter (11 acres) was marked for a selective cutting, in which all trees of undesirable species, form, or condition were removed. A third unit (9 acres) simulates ordinary commercial practice; all merchantable trees were cut. A fourth unit will remain untouched and will be used as a check area. General data on the entire areas were obtained, and more detailed observations were made on six half-acre permanent sample plots. A fifth unit, which includes a second-growth stand of yellow poplar, was cut to encourage the extension of the yellow Poplar, by natural seeding, into the area immediately below the poplar stand. On a sixth area, the cutting was designed to increase the proportion of chestnut oak in the stand. These various areas aggregate about 40 acres, and about 900 cords of wood were removed, most of it by the Asheville Community Woodyard Committee for unemployment relief. The extent to which these cuttings are successful in accomplishing the purposes for which they were intended will be determined by periodic observations and measurements of permanent sample plots established in each of the areas.

The results obtained from cuttings on permanent sample plots will serve for conditions similar to those on the plots; but the extremely wide diversity of forest

types and conditions in the Southern Appalachians necessitates a different procedure if anything like a comprehensive knowledge of improvement methods is to be gained. The only way to learn the facts as to forest conditions throughout the region would be by means of a thorough survey, funds for which have not yet been made available. The Station used the next best method within its resources which was to conduct a survey of a few representative cut-over areas in different parts of the region. Seventeen areas were selected which had not been burned since the last cutting and for which some information was at hand as to the history of cutting. The majority of these areas were on national forests. About 335 sample plots - temporary plots mostly one-half acre in size - were tallied on cut-over areas in North Carolina, Virginia, West Virginia, and Kentucky. This work occupied one field party in the summers of 1927, 1928, and 1929. No work was done in 1930.

The results have been compiled by different forest types, conditions, and ages of cut-over areas. The complete analysis, when finished, is expected to form the basis for a report on the condition of unburned cut-over areas. The preliminary compilation of these data, made for the bulletin "Timber Growing and Logging Practice in the Southern Appalachian Region", indicate that the average cut-over stands are only about half-stocked with trees over three inches in breasthigh diameter. Of these, 70 or 80 per cent, on the average, are crooked, unsound, or of relatively less desirable species. The figures bring out further that the reproduction on these areas is not particularly promising. The number of saplings that are unshaded and free to grow into trees is less than the number of shaded saplings; and of those free from shade less than half, as a rule, are of desirable species.

Future work. It is planned to continue this study much as in the past, with emphasis upon the solution of narrowed problems, such as the most efficient and inexpensive methods of eliminating spreading unmerchantable trees; comparative growth rates of sprouts and seedlings of different tree species and of shrubs; elimination of shrubs where too dense; and the efficacy of introducing different species by underplanting. In 1931 the men assigned to this project will spend a considerable part of their time compiling the results of past work and preparing a manuscript for publication on the results of the extensive survey of cut-over areas.

It is planned to establish a few methods of cutting plots in north Georgia next summer. Their purpose will be (1) to improve old-field hardwood stands by fuelwood cuttings, eliminating undesirable species and poor individuals of desirable species thus favoring the better trees for saw-timber production; and (2) to increase the proportion of pine in mixed stands on sites favorable to pine, and similarly to increase the proportion of yellow poplar and other desirable species on good sites.

Methods of Thinning in Mountain Hardwoods (Project Mt-2)

J. H. Buell in charge

Past work. In 1924 the Station began to gather data on the effect and relative value of various kinds and degrees of thinning in second-growth hardwood stands. Except for the plots established last summer in Georgia (reported under project M-2) the last work done on this project was in 1928 and 1929, when five half-acre sample plots were established in a 40-45 year old stand of yellow poplar on the lands of the Cranberry Iron and Coal Company, at Cranberry, N. C. A summary of the stands and of the work done was given in last year's annual report. Three different methods of thinning were used: a "selection" thinning, which removed the largest and best trees, leaving the smaller to develop; a "crown" thinning, in which trees were removed that were interfering with especially good trees chosen as crop trees to be brought through to the end of the rotation; and a "low" thinning, in which the smaller trees in the stand were cut, leaving the dominant trees with a little added space for later development.

Future work. Thinning studies by the use of permanent sample plots will be continued as in the past. In 1931 it is proposed to establish series of plots to test different kinds and degrees of thinning second-growth pine and yellow poplar in north Georgia.

Thinnings in the Biltmore Plantations (Project Mt-1)

E. H. Frothingham in charge

Past work. Four sets of permanent sample plots - two sets in white pine, one in shortleaf pine, and one in sugar maple - were established in 1916 by Frothingham, Verne Rhoades, and L. J. Young. One plot of each set was thinned in October 1916, January 1923, and April 1929. The relation of the thinning to the growth rate of the plots, as shown at the time of the third thinning, was described in last year's annual report. These plots are also discussed in United States Department of Agriculture Miscellaneous Publication 61: "Forest Plantations at Biltmore, N. C.".

Future work. The plots are to be thinned for the fourth time in the fall of 1933 or spring of 1934.

Natural Replacement of Blight Killed Chestnut (Project M-3)

A. L. Mac Kinney in charge.

The gradual disappearance of chestnut from the forests of the Southern Appalachians because of the ravages of the chestnut blight will materially influence their future composition. A knowledge of the nature, rate, and extent of the replacement of the chestnut by other species and the rate at which the growing stock of the forest will be restored by the replacement species will be important in framing future management policies for many timberlands.

Past work. Studies along these lines were started in the northeast in 1924 because the blight had then been active in that region much longer than in the Southern Appalachian region. These studies were conducted in cooperation with the Northeastern Forest Experiment Station and the results have been published.

Two permanent sample plots were also established in the Station's territory on the Shenandoah National Forest, in 1924. Since that time eight one-acre, two one-half acre, and 50 square rod plots have been established on the Shenandoah, Natural Bridge, and Pisgah (Bent Creek experimental forest) National Forests. These plots have been examined periodically since their establishment.

Future work. No more sample plots are to be established. The plots on the Shenandoah and Natural Bridge National Forests and three plots on the Bent Creek experimental forest are to be reexamined in the Fall of 1931. The data from all plots are to be compiled as rapidly as conditions permit. In order to obtain data applicable to conditions not represented by the sample plots and to strengthen the plot data, a limited amount of extensive strip cruise will be begun during the next several years. All results will be summarized for publication about 1935.

Forest Management in North Georgia (Project M-2)

L. I. Barrett in charge

Past work. A special allotment for work in north Georgia became available July 1, 1920, and a plan was drawn up for preliminary work in cooperation with State Forester B. M. Lufburrow and Director H. P. Stuckey of the Georgia State Agricultural Experiment Station. This plan provided for studies of the rate of growth and general condition of the hardwood forest; the preparation of a report for publication embodying the results of the studies and describing the forest conditions; and the establishment of a limited number of permanent sample plots for the study of growth and management on the lands of the Georgia Mountain Experiment Station near Blairsville. The leading purpose of the study is to furnish data and recommendations for forest management in the region, based upon field investigations of the condition, growth, and reproduction of typical stands.

Dr. C. R. Hursh was placed in charge of the work, assisted by Mr. Bonnell Stone, of Blairsville, and Messrs. Sims and Abell of the Appalachian station, for different periods. The study was confined to lands above 2,000 feet in altitude, mostly north of the crest of the Blue Ridge Mountains, and as far west as the towns of Ellijay and Blue Ridge. Most of the region studied lies within the three counties of Union, Towns, and Rabun, and the lands are owned largely by the Federal government (Cherokee National Forest), the Pfister and Vogel Land Company, and the Georgia Power Company. As commercial timber cruises were available to furnish a fair estimate of the forest composition for the region as a whole, no extensive surveys were made, the field party confining its efforts chiefly to the study of growth. This study was by means of sample areas, sixty-two of which were studied. Growth records were taken on some 1700 individual trees, by means of borings.

Three pairs of permanent sample plots were established on the 158 acre tract of the Georgia Mountain Experiment Station. In one a fuelwood improvement cutting was made, in another a clear cutting, while the third was thinned. The control plots are to be measured periodically to determine the growth rate in natural stands.

A detailed observation was made of condition classes as they occur on a representative cut-over forest area in the region as well as on the Georgia Mountain Experiment Station tract. The latter was classified into 12 condition classes, based upon the characteristics of stand and reproduction as brought out by the past history of the stand.

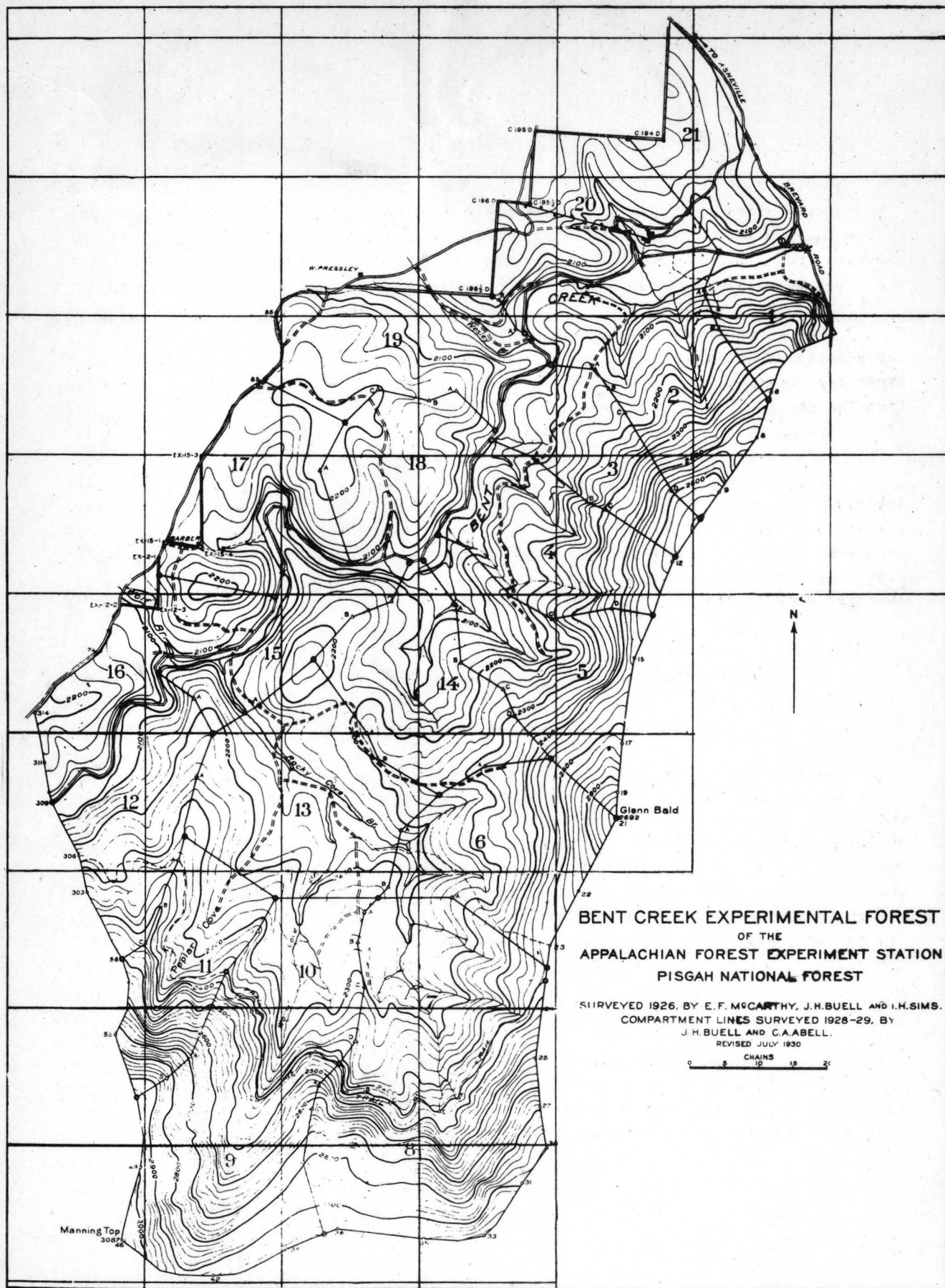
Future work. One purpose of the first season's study was to disclose the subjects that are in need of further investigation. It is recommended that this year's work follow three lines: (1) studies of rate of growth in uneven-aged mixed hardwood forest; (2) methods of cutting; and (3) thinnings in even-aged second-growth pine and yellow poplar stands. Since there is a separate investigative project for each of the two last named subjects, it is proposed to carry them on under those projects.

Management of the Bent Creek Experimental Forest (M-1)

J. H. Buell in charge

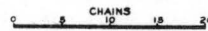
Past work. The Bent Creek experimental forest was established in 1926. It is located within ten miles of the Station's headquarters, at Asheville, N. C., and in the section of Pisgah National Forest which was once a part of the estate of George W. Vanderbilt, and which he consolidated about thirty years ago. Previously the tract was in small holdings, and several families made their livings by cultivating the flat cove bottoms and the rounded ridge tops. The abandoned fields are now growing up to pine. The forests surrounding them still show the effects of mis-use, for the settlers always cut the best trees and left the poorest. A large proportion of the older trees are fire scarred, though very little of the area has been burned within the last twenty or thirty years.

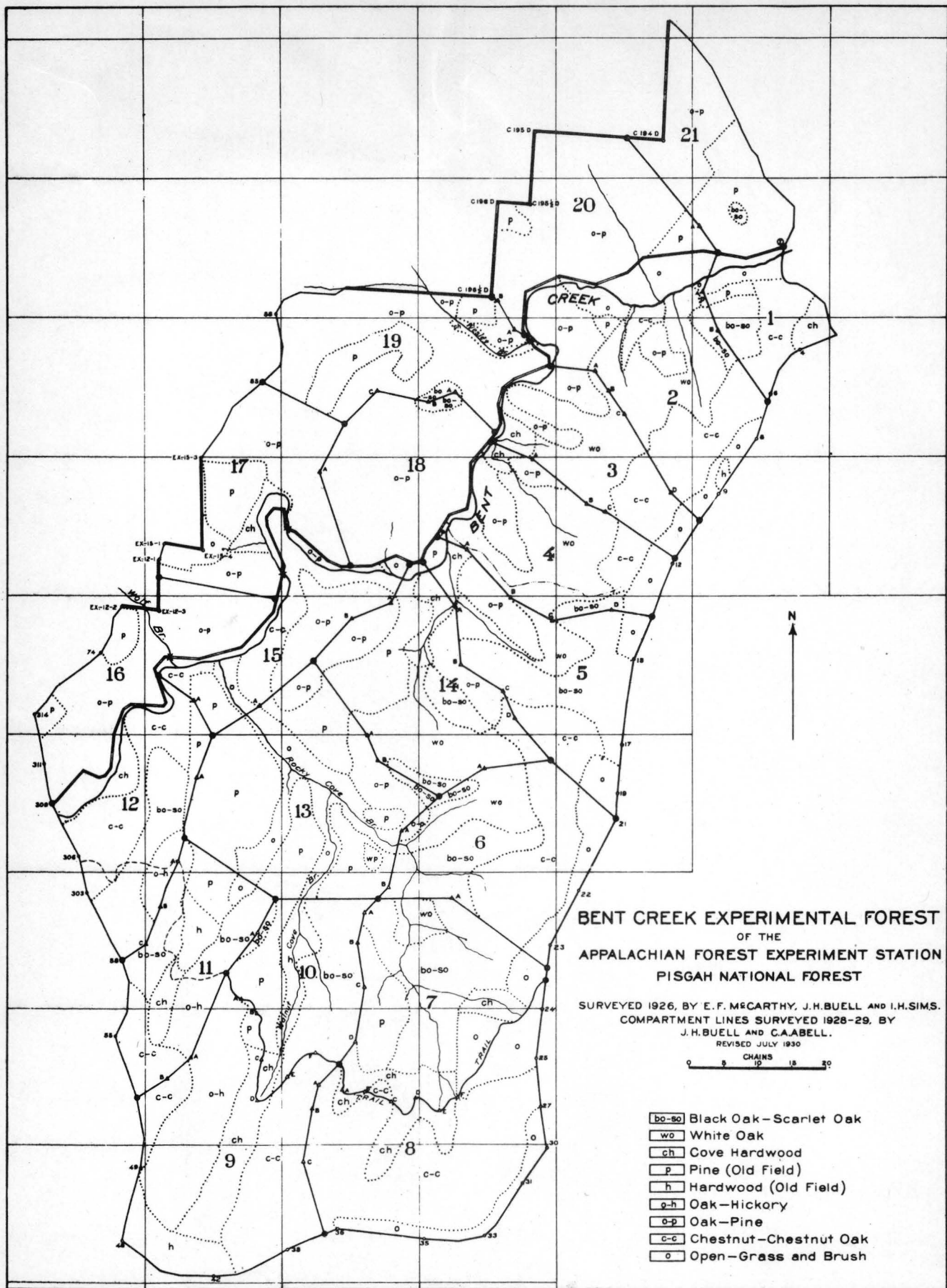
The tract contains 1100 acres. A ten per cent cruise that was run in 1927 divided the forest into nine forest cover types, and showed that the average stand for the area as a whole was only 1154 board feet per acre. The following table lists the forest types, and shows the area of each, the per cent of the whole forest which this area represents, and the stand per acre for the type.



BENT CREEK EXPERIMENTAL FOREST
 OF THE
APPALACHIAN FOREST EXPERIMENT STATION
PISGAH NATIONAL FOREST

SURVEYED 1926, BY E. F. MCCARTHY, J. H. BUELL AND I. H. SIMS.
 COMPARTMENT LINES SURVEYED 1928-29, BY
 J. H. BUELL AND C. A. ABELL.
 REVISED JULY 1930





Type.	Area acres.	Per cent of area of the forest	Stand per acre board feet (Scribner)
Oak-pine	297	27	794
Chestnut - chestnut oak	207	18	1,593
Black-oak-scarlet oak	143	13	1,438
Old field pine	130	12	762
White oak	106	10	1,997
Open	104	9	
C.ve hardwoods	62	7	1,158
Oak-hickory	35	3	3,188
Old field hardwoods	26	2	600
	1,110	100	1,154 (Avg.)

The 1927 cruise data have been allocated as well as possible to the twenty-one compartments into which the forest was divided in 1929. The compartments, based chiefly on topography, need further subdivision into the ultimate units for treatment based on forest composition and site qualities, so that in each unit the conditions for growth may be uniform. This work was begun in 1930, when compartments 1, 2, and 3 were subdivided. A cruise, approaching 50 per cent, was made of each unit by checkboarding it with square chain plots on which all trees 1.1 inches and larger in diameter at breast height were tallied by species and crown classes. The reproduction was counted on one one-hundredth part of each of these plots, and was recorded according to origin - i.e., seedling or sprout - and freedom to light, i. e., whether or not shaded by other growth in the forest. The data in the following table were obtained from these cruises.

Comp.	Unit	Area acres	Stems per acre	Volume per acre	Per cent of area cruised	Reproduction Stems per acre less than 1.1" d.b.h.			
			1.1" + d.b.h.	cu. ft 1/		Seedlings		Sprouts	
						F.	O.	F.	O.
1	b	4.6	403	1,329	67	2,289	3,457	2,289	6,904
	c	6.2	316	1,315	40	2,400	5,360	1,720	3,680
2	f	9.7	386	1,602	42	100	9,275	25	5,685
	g	11.4	435	1,962	46	46	9,055	0	9,392
3	e	6.0	461	1,680	42	520	6,320	840	7,000

1/ Entire stem less bark.

Experimental cuttings were made during the past season in five of the units which were laid off in compartments 1 and 2. On two other units in compartment 2, trees that had been killed by the 1925 blight were salvaged. These cuttings covered 40.2 acres, and are the most extensive that have been made in the forest since 1926 when the chestnut, most of which was infected by the blight, was salvaged for telephone poles and acidwood. The size of the units, yield of cordwood, and type of cutting, are shown in the following table:

Summary of cordwood cut at Bent Creek, November 1930, to March 31, 1931.

Unit.	Area	Quantity cut		Treatment
		on unit	per acre	
	<u>acres</u>	<u>cords</u>	<u>cords</u>	
c - 1	6.2	100	16	Clear cut
f - 2	9.7	235	24	Merchantable saw timber cut.
g - 2	11.4	314	28	Silvicultural improvement cutting.
e - 2	3.0)			
i - 2	3.8)	188	22	Dead trees and "wolf" trees removed
j - 2	1.6)			
k - 2	4.5	91	15	Cutting to favor chestnut oak.
Total	40.2	928	23	

The cordwood yield from unit C-1 is partly an estimate, since not quite all the wood had been measured at time of reporting.

On unit c-1 the shrubs and young trees were mowed down and then the stand was clear cut. On unit f-2, only the merchantable saw-timber trees 14 inches and over, breasthigh, were removed. On unit g-2, all crooked, spreading, and seriously defective trees were cut, together with all trees of inferior species, such as sourwood and dogwood. On unit j-2 a fairly heavy cutting was made just below a small stand of second-growth yellow popular, while the popular itself was thinned; the purpose was to find out whether successful reproduction of popular could be obtained on the treated area. On unit k-2, the cutting was designed to favor a reproduction of chestnut oak on a site favorable to this species. Unit i-2 is in the area that suffered severely from the drought of 1925. The special study of drought damage having been closed, the dead and badly injured trees were salvaged for the Asheville Community Woodyard.

In most of the units cut over half-acre sample plots were established; in units j-2 and k-2 they are to be established this spring. Photographs were taken of the stands before and after cutting, and the camera stations were marked so that future pictures may be taken from the same points to show the development of the stand.

A laboratory building and a garage were constructed at Bent Creek in 1926. Since then a pump and water system have been installed, and an insectary and woodshed have been put up. Six wooden platforms were built and tents set up on them last summer in order to relieve the congestion in the laboratory building, the loft of

which had previously served as a bunk room. During the coming spring it is planned to build laboratories and living quarters which will take care of the expanding work at this field station. A road which will cross the experimental forest twice and open it up for protection and utilization is already nearing completion.

Future work. The procedure that was started last summer seems well adapted for the experimental management of the tract, and it is recommended that this procedure be followed in future. The compartments should be subdivided into the ultimate treatment units, and these units should be cruised by a uniform method, so that results of the various treatments made on them may be comparable. These recommendations are to be incorporated this year in a management plan for the forest, which was postponed from last year to await the outcome of the procedure at that time under trial.

Reproduction, Growth, and Management of Loblolly Pine (Project M-111)

A. L. Mac Kinney in charge

As a result of heavy lumbering and recurrent fires, the loblolly pine lands of the mid-Atlantic Coastal Plain region are producing, in most cases, only a small fraction of their potential yields. Before it is possible to remedy this condition it will be necessary to know what methods of treatment will be most effective in converting the present stands in their various stages of depletion into good stands of merchantable timber. The purpose of the loblolly pine study is to obtain this information.

Past work. This project was initiated in 1927-28, with an extensive survey of reproduction on cut-over and burned loblolly pine lands. The results of this phase of the study are now being analyzed and will show in a broad way what is occurring naturally on cut-over and burned loblolly pine lands. The field work has been limited by lack of time and funds and its scope must be widened materially if its purpose is to be fulfilled.

During the course of this survey data were also taken on the growth of 1,500 trees left standing on logged areas. The analysis of these data shows that trees left standing on logged areas increase in growth materially after liberation, the rate of increase depending mostly upon the diameter of the trees at the time of cutting, per cent of the stand removed around them, and the size of their crowns.

A study of change in form of trees left after logging was begun in 1928, but has not been completed. Preliminary results show a quite definite tendency for trees released by logging to grow more rapidly in diameter above breast height than at breast height.

In the autumn of 1929, six sample plots, each 2.5 acres in size, were established in a mixed stand of loblolly pine and hardwoods on the lands of the Camp Manufacturing Company at Franklin, Va. These plots were marked for a selective cutting, and cut over and treated in different ways to study the establishment, development, and growth of reproduction under controlled conditions. On these plots different methods of treating undesirable hardwoods were studied. Preliminary results show that poisoning of the trees with sodium arsenite solution introduced in axe cuts is considerably cheaper in addition to being more effective than girdling and felling.

Early in 1930 four two-acre plots were established in an old-field stand of loblolly pine of the lands of the Foreman Blades Lumber Company, near Windsor, N. C. These plots were subjected to different degrees of cutting, from light to heavy, in order to determine the effects on the growth of the remaining trees and on the establishment and growth of subsequent reproduction.

On both the Franklin and Windsor plots the Station cooperated with the Forest Products Laboratory in a detailed study of logging and milling costs and financial returns. Only the data for the Franklin plots have been analyzed to date. Among the many interesting and valuable facts brought out was the conclusion that for this operation no loblolly pine under 13 inches d.b.h. could be cut at a profit.

The work to date in this project has been on a relatively small scale and accordingly the results obtained are quite limited in scope. The main value has been to point out the need for a greater amount of work in the future when funds are available.

Future work. During the spring of 1931 a third selective logging study will be carried out on the lands of the North State Lumber Company, near Witherbee, S. C., in cooperation with the Forest Products Laboratory. This study will serve to round out the information on costs and profits of logging and milling trees of different sizes; also, since the area to be studied was cut over thirty years ago, information will be available on the increase in growth and quality of lumber to be expected in trees left standing after logging.

In addition to this study the only field work for the coming year will be the reexamination of the reproduction quadrats on the plots at Franklin, Va., and Windsor, N. C.

An effort will be made during the coming summer to bring all computing work on the project up to date and compile the data obtained in the selective logging studies for inclusion in a joint report, by the Forest Products Laboratory and the Station.

Thinnings in Southern Pines (Project Mt-3)

A. L. Mac Kinney in charge

Past work. The study of the effects of thinning on loblolly pine and other southern pines should answer many questions as to the management of young stands of these species. Work on this project, however, has been very limited. Three permanent sample plots were established in a stand of shortleaf pine on the Page Estate, Hanover County, Va., during 1913. Two of these plots were thinned and the third was left as a check. They were examined in 1919, 1925, and 1930. The data have not been analyzed.

Five plots established in 1925 in a stand of longleaf pine on the Southern Railway Demonstration Forest, at Pregnall, S. C., were taken over by the Station in 1930, remeasured, and enlarged from .229 to .25 acres each.

Future work. The data obtained from the Hanover County, Va., and the Pregnall, S. C., plots will be analyzed and included in memoranda. These plots will be examined and rethinned as necessity arises. No more plots are planned for the immediate future.

PROTECTION

The present work in forest protection falls under the heads of the effects of fire upon forest soils and trees, investigations in forest pathology, and studies of insects injurious to forest trees. The last two named investigations are under the direction of the Office of Forest Pathology, Bureau of Plant Industry, and the Division of Forest Insect Investigations, Bureau of Entomology, in cooperation with the Forest Service. Another protection project, damage of forest trees from the drought of 1925, was completed in 1930. The final report will appear in Ecology under the title "Effects of the 1925 Summer Drought on Southern Appalachian Hardwoods", by C. R. Hursh and F. W. Haasis.

The working plan for the study of effects of fire, as revised May 10, 1930, states that the object is "To determine the influence of forest fires upon standing timber, regeneration, and site, - - - for the purpose of standardizing methods of appraisal of fire damage and for the purpose of furnishing basic information pertinent to the restoration and management of fire damaged forest areas". The study naturally divides into two parts, one dealing with the effects of fire upon standing timber and reproduction, and the other with its influence upon the forest soil.

Effects of Fire Upon Standing Timber and Reproduction (Pf, A-1, Tree Phase)

C. R. Hursh and I. H. Sims, in cooperation with R. M. Nelson.

This study is being conducted on selected areas in the various forest types of the mountain region. Some phases of the project, such as that dealing with the relationship between external evidence of fire and actual wounding, can be conducted on areas burned naturally; others such as those having to do with growth, health, and mortality subsequent to the fire are best prosecuted on experimentally burned permanent sample plots. Still other lines of investigation will lend themselves to laboratory experimentation.

Past work. The study of physical fire damage to stands was carried on by E. F. McCarthy from 1922 until 1926, when active field work on this phase of the project was suspended. McCarthy used the method of extensive surveys, supplemented by semi-permanent plots established in representative burned areas at six localities in Pisgah National Forest. These have been examined at intervals since their establishment.

During the progress of the extensive survey 311 acres of strip were examined. The data obtained, together with those from the semi-permanent plots, were summarized in a progress report in 1926 by McCarthy.

Work on the physical damage phase was resumed in 1930, on a slightly different basis. All the previous observations and measurements were made subsequent to fires and lacked exact knowledge of conditions existing before the fire. To obtain comparisons of conditions before and after fire, it was apparent that controlled experimental burns were necessary. A series of plots was accordingly established at Bent Creek during the winter of 1929 and spring of 1930. One of these was burned over on April 10, 1930.

Before the plot was burned detailed descriptions of the individual trees larger than 1.5 inches d.b.h. were made. The reproduction present on the area at this time was determined by temporary quadrat methods. Suitable check plots have been established on which the same measurements and descriptions have been made as on the burned plots. The trees larger than 1.5 inches d.b.h. on the burned plot were examined and described again in July, 1930, subsequent to the fire. The establishment report on the series of plots contains summaries showing condition of trees, stand, and reproduction, before and after burning and on the check plots.

The plots established in 1929 at McFalls Creek, Va., (Natural Bridge National Forest) for the methods of cutting study, which were burned over in April, 1930, were examined during July and August, 1930. The excellent records available for these plots before the fire render them useful in the study of physical damage, particularly to reproduction. The report of the 1930 examination of these plots is nearing completion.

The importance of fire wounds on the boles of forest trees as an avenue of entrance for wood-rotting fungi has long been recognized, but careful studies of the subject have been lacking. Because of mutual interest of pathologists and foresters in the problems associated with this form of fire damage, a study of basal wounding was inaugurated during the summer of 1930, in cooperation with the Office of Forest Pathology, Bureau of Plant Industry.

The McFalls Creek burn provided excellent conditions for the prosecution of the cooperative study of basal woundings. The observations during the summer of 1930 were confined chiefly to five species - white oak, chestnut oak, black oak, scarlet oak, and yellow poplar - although a few trees of other species were examined. The data are now being analyzed. Preliminary computations, however, indicate that considerable differences exist between species and diameter classes in the ratio of area actually wounded to the area of external discoloration. The study has also brought out the fact that wounding may occur far beyond the limits of discoloration.

The McFalls Creek area burned over during the critical period in April, is one of the most disastrous fires the Natural Bridge National Forest has had. On the upper slopes and tops of the ridge bounding the McFalls Creek watershed on the north the stand was completely killed. This provided opportunity for the study of sprouting characteristics of fire-killed trees of a number of species. Several days were spent in accumulating field data. These are now being analyzed.

Advantage was also taken of the cutting now in progress in the McFalls Creek area to make some observations on the amount of cull and defect resulting from heart-rot, which entered through fire wounds. Measurements were made on fifty mature white

oaks which had been cut, to determine the scale of the material taken and of that left in the woods. Dr. R. M. Nelson, who cooperated on the observations, identified the causal fungus of the rot where this was possible.

In addition to furnishing a basis for conclusions as to the various forms of fire damage and a method of rating fire intensity, the extensive survey procedure used in the earliest stages of this project has indicated the need for detailed experimental procedure in the fire damage studies. The 1930 studies were accordingly planned and executed with this in mind. The results obtained justify proceeding along this line of attack in further investigations.

Future plans. During 1931 it is planned to concentrate upon the following six activities:

1. Revision and extension of the progress report prepared by McCarthy on the results of the extensive survey of burned areas.
2. Reexamination of the semi-permanent sample plots established by McCarthy subsequent to fires. These plots were established five or more years ago and will furnish reliable data on cumulated mortality to be included in the progress report which will be prepared.
3. Reexamination of the burned permanent sample plot at Bent Creek with special attention to mortality and recovery of large trees and accessions to the reproduction. The data from this plot will supplement those from McCarthy's semi-permanent plots.
4. Selection of areas suitable for series of permanent plots similar to that at Bent Creek. The Bent Creek plots are representative of the shortleaf pine-oak mixture on south slopes, but other types and condition classes merit attention.
5. Extension of the study of basal wounding to fall and winter burns and to other species than the five studied during 1930. Such expansion must be made in order to provide an adequate basis for the appraisal of this form of damage.
6. Investigation of bark characteristics and their bearing on the insulating properties of the bark of various species. This study is necessary for an adequate investigation of basal damage.

The last two activities listed will be carried on in cooperation with the Office of Forest Pathology, Bureau of Plant Industry. Of these, the last is a new study for which a tentative working plan is being prepared.

Other new investigations planned for the future, but whose prosecution in 1931 is problematical, will deal with the following:

1. The effects of bark structure and characteristics on the relative ease with which various barks are discolored by fire.

2. The effects of basal wounding on rate and path of sap movements.
3. The seasonal and species differences in the thermal death point of cambial cells.
4. The effect of forest fires in modifying the rooting habits of trees.
5. Rootsuckering and the role of fire in promoting or hindering it.
6. The relation between size and sprouting capacity for silviculturally important species.
7. Crown injury and its relation to growth rate.

Effects of Fire Upon Forest Soils (Project Pf. A-1, Soil phase)

Dr. C. R. Hursh in charge

Past work. This phase of the study of effects of fire was started by Dr. Hursh in 1928 at several points in the mountain region of North Carolina, Kentucky, and West Virginia. Because the field of forest soils as influenced by fires is comparatively unexplored, the preliminary studies in the field have been largely those of orientation and analysis of significant problems. Also it was desired to develop methods of technique suitable for studying the characteristics of soils that have been influenced by fire. Investigations of forest soils at the Appalachian Station began with the development of survey methods through a general field study of soil profiles under burned forest areas. Subsequently a more intensive investigation was conducted to devise methods for studying changes in the physical properties of the mineral soil horizons. This study was later supplemented by a study of methods for investigations of the organic horizons of the soil profile. Several entirely new methods were developed for studying the characteristics of soils influenced by fire, with the purpose in mind of determining the comparative application of such methods to general field procedure.

For studying changes brought about by fire in the physical properties of the mineral soil horizons, a number of methods were tried out. The structure of the soil particles, for example, was studied by several procedures. A special process was developed, employing the principle of disassociation of aggregates of dry soil in water at a constant temperature and the fractionation and classification of the resulting soil particles by a process of elutriation employing a special set of standardized sieves. The principle of the above process is that of Buyouccos, with the exception that standard sieves are employed for the larger particles that are difficult to fractionate by means of the hydrometer. Although the method as developed was suitable for the problem, it must be pointed out that significant differences in the structure of the mineral soil are rarely brought about by ordinary forest fires. The method is highly suitable for special studies of changes in the mineral soil, but it is not a method that should be applied generally in comparing burned and unburned soils. In fact, it is evident from the studies so far conducted that detailed investigations into the structure of the soil aggregates of the lower horizons of the soil profile is more a field for pure research into soil physics than it is fundamental to the practical problems of fire damage to forest soils.

It may now be stated that in general for the mountain region changes in the physical structure of the mineral soil due to fire are not of great significance in comparison with the changes that occur in the surface organic horizons of the soil. It has become evident, however, that fires may influence the organic material of the soil to such an extent as to produce a complete change in characteristic constitution of the organic horizons of the soil profile. These influences may be of such importance as to change the character of the humus type. In mountain areas that have been repeatedly burned, the surface organic layer of the soil may change from a loose, rapidly decomposing horizon to a compacted, felt-like mat, in which decomposition is restricted to a relatively slow fungous activity that takes place under dry acid conditions.

The herbaceous ground cover may also change along with alterations in the organic horizons of the soil. This fact suggests that a thorough study of floristic change following mountain fires probably furnishes a very useful indication of the extent of fire damage to the soil.

During the past year a detailed study has been made of the rate of decomposition of charred and partially burned hardwood litter as compared with normal unburned litter. The results of this study show quite strikingly that litter that has been charred or partially burned decomposes much more slowly than normal litter. This fact seems to help explain the change in humus type that may follow repeated or unusually severe burning.

Future work. The studies of soil damage by fires that have been completed to date clearly point out the need for a thorough and comprehensive investigation of the different humus types that occur in the mountain hardwood region. As fires have been the chief factor in bringing about the important characteristics of humus types, a study of these humus types will furnish a most important practical basis for estimating fire damage. It is now proposed that a thorough taxonomic analysis be made of the humus types that occur in the southern mountains, and that these humus types be correlated with forest types that are found within the region.

As a part of the classification procedure for the humus types, laboratory and field studies will be conducted designed to establish characteristic differences that may govern the rate of organic decomposition in the surface soil horizons. These studies will include such factors as the delayed decomposition brought about by charred litter, changes in the nature of the biological action due to repeated fires, and associated problems. The general study of humus types will include a wide range of forest conditions throughout the Southern Appalachians; the laboratory studies will be centered at the Bent Creek Experimental Forest, and other scientific laboratories in the territory to be studied.

Controlled Burning in the Longleaf and Loblolly Pine Types
(Project Pf. C-3)

A. L. MacKinney in charge

Controlled burning as a means of protection from disastrous fire is still ad-

vocated by many people in the southern pine region, although results of past experiments have indicated deleterious effects of annual fires in retarding growth and killing reproduction. Accordingly a study was initiated to obtain exact data on the effects of controlled burning on natural reproduction, growth, and soil conditions, in the longleaf and loblolly pine types.

Past work. During 1925 the Southern Forest Experiment Station began burning experiments near Lanes, S. C., on three contiguous areas having a variety of species and conditions of stocking. One of these areas of approximately 18 acres was designated for annual burning while the other two, aggregating six acres, were reserved for checks. A number of small plots were established on each area for more intensive study. These experiments were later turned over to the Appalachian Station.

During January 1929, the areas were resurveyed by the Appalachian Station and more small intensive study plots established. Since that time the one area has been burned annually and the intensive study plots examined each spring and fall.

The results of the study on these plots to date definitely show the harmful effects of the annual fires on the reproduction. On the annually burned area most of the hardwoods and loblolly pines under one inch in diameter at breast height, have disappeared except for the hardwood sprouts which have sprung up each year. Also many of the small longleaf pines, especially those under 10 feet in height, are showing the effects of the annual defoliation by a great reduction in vigor. No effects of the annual fires are noticeable yet in the growth of the larger trees.

During 1930 two 1/3 acre permanent sample plots were established on the Clemson College Coastal Experiment Farm near Summerville, S. C. One of these plots was established on an area which has been burned annually for 13 years and the other on a contiguous area which has remained unburned for the same period. Analyses of the data from these plots show an average reduction of approximately 15 per cent in diameter growth and 25 per cent in height growth of the individual trees, which may be attributed to the effects of the annual fires.

Soil samples from both Lanes and Summerville have been studied by C. R. Hursh, Forest Ecologist for the Station.

Future work. The Lanes plots will be reexamined during the Fall of 1931, and the one area burned over again if there is sufficient fuel to carry the fire. One of the Summerville plots, also, will be burned over.

Forest Pathological Investigations

Dr. R. M. Nelson in charge

Work done in 1930. The study of bluestain fungi in pines attacked by bark beetles was continued. Results from inoculations and physiological experiments confirm those from previous years and indicate that the death of pines within a few weeks after attack by the southern pine beetle is largely influenced by the associated bluestain fungi.

Seventeen hundred oriental chestnut seedlings were planted on the Bent Creek

experimental forest and 350 were planted on Mount Mitchell. In spite of the severe drought, a gratifying survival was obtained. By plots, the lowest per cent of survival was 29, the remainder ranging from 64 to 85 per cent.

In cooperation with I. H. Sims, an intensive study of approximately 350 fire-scarred trees, principally white, black, scarlet, and chestnut oak, and yellow poplar, was made on the McFalls Creek burn in Virginia. This study is reported in more detail in the discussion of the study of the effects of fire on standing timber and reproduction.

Future work. Further inoculations, and experiments on water conduction in bluestained trees, are planned. Past work indicates that conduction in stained areas of trees is greatly reduced; future work will attempt to determine the reason for stoppage.

In addition to cooperative work on insulating properties of bark, thermal death points of the cambium of different species, and physiological studies on fire-scarred trees, particular attention will be given to the study of rate and type of decay beneath fire scars of different ages, rapidity with which fire scars heal, and influence of repeated fires on entrance of decay.

The comparison and identification of the large number of cultures and specimens of heart-rotting fungi in oak will be continued.

Forest Insect Investigations

R. A. St. George in charge

Work done in 1930. In accordance with the policy adopted in 1925, when the entomological work at the Station was begun, the studies for 1930 centered around the southern pine beetle, (Dendroctonus frontalis Zimm.) one of the insects most destructive of pine in the South.

The program of work consisted of two phases: (1) fundamental physiological studies and (2) wood preservation studies. Mr. R. Caird was largely responsible for part 1, and Mr. St. George for part 2.

The physiological studies were concerned with factors important in the mechanism of the death of trees, as well as those responsible for the distribution of poisons in beetle-fungus-attacked trees. The moisture gradient was determined for (1) ten normal pines, (2) several infested unpoisoned trees and (3) for many infested poisoned ones, as to (a) phloem, (b) first two rings, (c) next three rings, (d) the remaining center and (e) the cross-section as check. In addition, other studies were made which were of importance in connection with tree injection experiments, such as the rate of transpiration and the distribution of poison in trees injected by the saw kerf method. Through the cooperation of the Insecticide Division of the Bureau of Chemistry and Soils, arrangements were made for a quantitative analysis of samples obtained from the above mentioned poisoned trees.

The wood preservation studies were for the purpose of determining the possi-

bilities of killing insects in infested trees, as well as to preserve the wood from sap-staining and wood-destroying fungi, when they were injected with poisons by the saw-kerf method.

Normal pine and oak trees were also poisoned in the above manner to prevent the wood from being attacked by insects and fungi subsequent to felling. Trees successfully treated in this way could be cut at any time of the year and be used for rustic purposes without the usual danger from wood-destroying agencies. Several poisons were found that were quite promising in this respect.

Evidence obtained during the past five years in the study of environmental factors governing epidemics of the southern pine beetle, has shown that trees weakened by a marked deficiency in rainfall are attractive to this beetle. Therefore, it is not surprising that during the record breaking drought year of 1930 there occurred one of the largest outbreaks of this beetle since 1910 to 1911. Serious outbreaks occurred in Western North Carolina and Eastern Tennessee, especially in the vicinity of the national park area of the Smoky Mountains. Many smaller outbreaks were reported from the Pisgah and Unaka National Forests. A survey to determine the extent of injury caused by this beetle is planned for 1931.

Plans for 1931.

Southern pine beetle. Physiological studies will be made to determine more exactly the mechanism of the death of beetle-attacked trees. Further studies will be made on natural factors affecting beetle abundance, as well as that of reproduction following thinnings by Dendroctonus frontalis.

Tree injection. Observations will be continued on those trees poisoned during 1930, to note their effectiveness against insects and fungi. Both normal and infested trees will be injected to determine new chemicals effective for this purpose, as well as to test trees with dosages of strengths used in commercial practices.

Protection of felled logs. Pine and hardwood logs are to be sprayed with some of the chemicals used in injection experiments to compare the effectiveness of the two methods. Other treatments are for the protection of green logs in storage.

FOREST INFLUENCES

Relation of Forest to Streamflow and Erosion (New Project I-1)

Dr. C. R. Hursh, In Charge.

Investigations of the function of forests in controlling erosion and in the regulation of streamflow have been recognized as being particularly pertinent to the Appalachian region. In this region of rough topography there occurs the highest annual rainfall in the eastern United States. The Appalachian Forest Research Council has been active in calling attention to the necessity for a thorough study of erosion and streamflow with particular reference to the significance of forests and other vegetative cover in these important problems.

As a result of the united request on the part of the Research Council and other

citizens interested in the proper handling of the water crop from forest lands for municipal use, power, etc., a share of the appropriation this year made available by Congress for studies of forests and streamflow has been granted to the Appalachian Station. Beginning June 1, therefore, the Station will start an investigation to determine the most efficient utilization of the water available from forest lands, and to gain a better understanding of the factors that govern the rate and amount of soil erosion.

The preliminary phases of this project will include the compilation of all available information on precipitation and stream movements throughout the year. This information will be correlated with forest areas and topography. The erosion problem will begin with a field survey of the soil and humus types now undergoing erosion, and will proceed with a study of the factors that tend to produce such humus types. Experimental areas will be used to study both the streamflow and the erosion phases of the project. For the first season this project will be associated with the present existing forest soil and fire damage project. Later plans for the study will be made as the work develops; they will undoubtedly include comparative measurements of run-off and erosion under different conditions of soil, humus, and vegetative cover.

FOREST MEASUREMENTS

This subject is maintained to cover special studies in which measurement is a prominent feature. The Station has under way at present only a single minor project, growth sample plots (ME-1); but another project, growth in irregular stands, is recommended for the coming year. As will be shown later, the subject of growth is so important that it should command an early increase of the Station's resources sufficient to make this one of the major fields of activity in the Coastal Plain, as well as in the mountains.

Growth Sample Plots (Project ME-1)

L. I. Barrett, In Charge.

Past work. The purpose of this project is to learn from observations of the growth on measured sample plots (1) the relation of different qualities of site to the growth rate, (2) relation of crown size and condition to growth rate, (3) the best stocking of stands and the relation of the present stocking to the future growth rate, and (4) the rotation ages for different tree species and products. Work was started in 1926, when a pair of permanent sample plots, each .4 acre in size, was laid out in young stands on Star Gap Branch of Curtis Creek, Pisgah National Forest, and another pair, $\frac{1}{2}$ acre each, at Berea. No other plots have been established.

Future work. Eventually there should be many such plots to represent different forest types and condition classes. They should be established where there is opportunity, at branch stations. In 1931, some will be put in if juvenile stands suitable for the purpose are found.

PLANTING

Tests of Species for Planting (Projects Fp-2,3,4)

I. H. Sims, In Charge.

Past work. The purpose of the planting studies so far made has been to ascertain the species most suitable for forest planting in two widely different environments, first, the high altitude spruce and balsam lands, and second, the pine and hardwood belt at lower elevations. The small experimental plantings have been confined to several adjacent areas at elevations of between 5,500 and 6,500 feet on Mount Mitchell and vicinity, and to old fields in the Bent Creek valley. These areas are accessible and are adequate for the project in its present status, but an extension of the study to other sites will be necessary to answer many questions as to the best species for planting in the Southern Appalachian region.

Since 1923, 80 test plots of 100 trees each have been established in the spruce type. Seventeen species, all of which are conifers, have been used in the tests under various conditions of age and class of stock.

At the lower altitudes, about 50 species have been planted. The plots vary in size and contain from half a dozen to 300 trees. The greatest number of species have been planted in the arboretum at Bent Creek in small plots. The larger plots are chiefly on national forest land in the Bent Creek valley but off the experimental forest.

The plantations have been observed at intervals since their establishment but their age does not justify any broad conclusions as to the suitability of the species for general use in the region.

Lack of funds and personnel, rather than of merit or interest has been the chief deterrent to more rapid expansion and vigorous prosecution of these studies. The small allotments made available for planting have been reflected in the small sizes of test plots. This, in turn, is bound to affect the value of the results. It is to be hoped that the funds for the forestation work will soon be commensurate with the importance of the studies.

Future work. During 1931 the work will be restricted in scope. The small stock of trees on hand in the nurseries will be field planted, but no seed is to be sown. Existing plantations are due for reexamination during the year and this should be done.

BOTANICAL STUDIES

Phenology (Project BS-1) J. H. Buell, In Charge.

The study of the yearly cycle of growth, from the swelling of the buds of a tree in spring to the dropping of the leaves in autumn, is called phenology. The relation of this cycle to the progress of the seasons has an important place in forest work; for example, records of the time of leafing, flowering, and fruiting of trees serve as guides to the timing of cuttings for reproduction by seed and by sprout, girdling, seed collecting, and other silvicultural operations.

Three things are necessary if thorough phenological records are to be obtained for the whole territory of the Station. (1) Observation stations must be located so as to cover all the territory; and must be numerous enough to accommodate the wide variety of conditions of geography and topography, (2) These stations should be located near weather stations. (3) Records must be kept continuously over long periods of years.

Past work. Phenology was inaugurated as a project at the Station in 1929. So far work on it has been confined to the developing of a technique for the collecting and recording of data. To that end, the leafing and flowering of some 14 tree species and 7 shrubs were followed last spring at four different points on the Bent Creek Forest. A large number of pictures were taken. Certain subjects were photographed repeatedly to show pictorially the seasonal changes. Photography may be valuable both for the actual records obtainable, and as an aid in instructing observers.

Future work. Some phenological records are being made at present by the national forest forces. It is planned to coordinate all such efforts on the national forests in the Appalachians, and to solicit the help of forest schools, educational institutions and state departments throughout the territory. This is in accordance with a tentative scheme which has already been prepared. In time valuable records for the region should be available for the guidance of all sorts of field activities in forestry.

BIOLOGICAL INVESTIGATIONS

T. D. Burleigh, In Charge.

Past work. The biological investigations were started in 1930. As the basis for all biological work is a thorough knowledge of the wild life now present on any area to be studied the preliminary work this past year has involved detailed observations of the distribution and abundance of the birds and mammals indigenous to western North Carolina. This is but a relatively small area in so far as the region as a

whole is concerned, but it was felt advisable to limit activities somewhat rather than to attempt too ambitious a program at the start. Two weeks in January, however, were spent on the coast making a brief survey of conditions there, and, as opportunity offered, brief trips were made into South Carolina and Georgia to correlate the distribution of bird and mammal life there with that in the mountains of western North Carolina. While taxonomy is but one phase of this work it seemed desirable, at the beginning, to settle definitely any uncertainty concerning the subspecific identification of both birds and mammals, and with this object in view rather intensive collecting has been carried on. In the case of the birds small series of certain species were taken where this was felt essential to settle any questions that had arisen concerning either their actual status or the possible effect of environment on species resident within a rather restricted area. This material will be of considerable value in working out life zones in this region, for it has been some years since any biological field investigations have been carried on in the Southern Appalachians, and then only to a very limited extent. Actually there exists a real need for specimens from these mountain slopes.

In each case where a mammal was trapped or a bird collected, the stomach was carefully preserved and sent to Washington for an analysis of its contents. The issue directly involved is the relationship of wild life to the forests, and a knowledge of food habits is very essential in this respect. Intensive trapping of the smaller mammals has been carried on to determine their influence on the reproduction of such species as the oaks and the yellow poplar. They have proven unexpectedly scarce, records kept for over a year indicating a population of one pair of mice to the average acre here. As an example of this a one-acre sample plot on the Bent Creek experimental forest, which was to be burned for experimental purposes, was carefully trapped for a period of four weeks prior to burning, and but one pair of white footed mice (Peromyscus) was caught during that length of time. As a check on the return of rodents to burned over areas, this same plot was intensively retrapped for the same interval a year later and but one white footed mouse was caught and that undoubtedly had wandered in from nearby. It is too early to make definite statements concerning rodent damage, but present indications are that they are a minor factor in the destruction of desired reproduction.

In this connection, however, it must be realized that there may be a considerable fluctuation in the number of rodents over a period of years, due to available food or an increase or decrease of predators, and such facts must be carefully ascertained.

Deer on the other hand are probably largely responsible for this destruction, and to determine this as definitely as possible, and also to gain a more thorough knowledge of their food habits, their stomach contents were given special consideration during the fall months. Through the able cooperation of the personnel of the Pisgah National Forest, the stomachs of all deer killed by hunters on hunting preserves, lying within the boundaries of the Forest, were secured and an analysis of these should yield information of considerable value.

Deer are fortunately not very susceptible to disease so an unexpected epidemic this past fall on the Pisgah National Forest was given considerable study. The majority of the animals found dead were too badly decomposed to be handled but one reason-

ably fresh specimen was, with the aid of a veterinarian at Hendersonville, thoroughly examined but with negative results. Another specimen was sent to the Bureau of Animal Industry at Washington, D. C. In each case there was no evidence of any known disease and present surmise is that the animals were poisoned through eating plants normally untouched when vegetation was unharmed by such a drought as existed this past summer.

Game birds, the ruffed grouse especially, are rather scarce in this region, and as trapping has indicated the presence of a very large population of such predatory mammals as the gray fox and skunk, a study is being carried on of their actual numbers and the relationship of their food habits to the survival of these birds.

Plans for 1931.

Distribution and life histories. These studies will be continued in detail with a wider area to be given consideration. Proposed plans include a continuation of work carried on in Georgia and on the coast of both North Carolina and South Carolina. In addition a preliminary survey will be made in the mountains of West Virginia.

Food habits. Through the collection of specimens of both birds and mammals for identification and to substantiate the presence of certain species in this region, stomach contents will as heretofore be available for careful analysis. It is felt that it would hardly be possible to have too much of this material on hand, and that information secured in this manner will prove of real value in acquiring a thorough knowledge of relationships. A scarcity of mast on the Bent Creek area this past fall rendered inadvisable any experiments concerning the destruction of this seed by both birds and mammals, but it is hoped to remedy this situation this year.

Game management. Studies will be continued of the effect of deer on forest production, and the present scarcity of ruffed grouse will be given consideration to determine possible means of increasing their numbers to a more normal ratio.

SPECIAL INVESTIGATIVE NEEDS

Forest Survey

The need for a better knowledge of the timber area and stand in the Southern Appalachian region is met constantly in the Station's work. At present only the most general estimates are available, and the lack of reliable information is one of the most serious handicaps to the progress of forestry in the region.

Funds for a "comprehensive survey of the present and prospective requirements for timber and other forest products in the United States, and of timber supplies, including a determination of the present and potential productivity of forest land therein," are definitely authorized in Section 9 of the McSweeney-McNary Act (S. 3556, 70th Congress). This survey is now under way in several of the forest regions of the United States.

It is strongly recommended that this survey be extended in the Fiscal Year 1933 to the Southern Appalachian region. At the outset it is believed the survey should be confined to the mountain region, aggregating ten or twelve million acres. No recommendation can be given at this time as to the procedure to be employed, but the methods now in use elsewhere will of course be studied to determine the degree to which they may be used for Appalachian Mountain conditions.